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Population-Level Patterns and Mental Health and Substance Use Correlates of Alcohol, Marijuana, and Tobacco Use and Co-Use in US Young Adults and Adults: Results From the Population Assessment for Tobacco and Health

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Abstract

Background and Objectives: This study identified the most common patterns of current alcohol and marijuana use with the spectrum of tobacco products (cigarettes, hookah, e-cigarettes, cigars/little cigars, and other products), among US young adults and older adults and examined associations of mental health and substance use problems with each pattern.

Methods: Wave 1 adult dataset (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study. Weighted analyses estimated the prevalence of the top 10 patterns of current alcohol, marijuana, and tobacco use and co-use separately by young adults aged 18–24 ($n=9,112$) and adults 25+ years ($n=23,208$). Multivariable models examined associations of substance use and mental health problems to patterns of use, adjusting for demographics.

Results: Across both age groups, alcohol-only use was the most popular use pattern (20.7% for young adults and 32.2% older adults) however poly-substance use patterns were more frequent than single use patterns. Cigarettes were the only tobacco product used exclusively; all other tobacco products were used with together, or with alcohol or marijuana. Only one young adult pattern emerged containing e-cigarettes, and this pattern included co-use with alcohol and cigarettes (1.3%). Mental health and substance use problems were most strongly correlated with dual and poly-substance use patterns, regardless of age.

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Declaration of Interest

The authors report no conflicts of interest.

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Scientific Significance: Prevention and intervention campaigns should focus on multiple product use, as single substance use is uncommon. Alcohol is common in all patterns, suggesting it should also gain more focus in marijuana and tobacco prevention and intervention programs.

INTRODUCTION

Increases in the use of a broad array of tobacco products, like hookah, e-cigarettes, and little cigars/cigarillos (LCCs) has been pronounced among US young adults, with recent estimates indicating that 33% of young adults report past 30-day tobacco product use¹ and just over 60% report multiple tobacco product use.² The co-occurrence of tobacco product use with alcohol and marijuana is also common in this age group,^{3–5} with most studies showing three quarters of current tobacco using young adults reporting current alcohol use^{6–8} and between 25% and nearly 60% (depending on tobacco product) of current tobacco users reporting current marijuana use.^{8–10} The co-use of alcohol or marijuana with tobacco products are associated with increased risk for mental health and other substance use problems,^{3,9} nicotine dependence, lower desire or motivation to quit using tobacco,¹¹ and poor tobacco cessation outcomes.¹² Research is needed to understand how alcohol, marijuana, and tobacco products are used together to inform targeted, effective interventions, and policies to improve public health outcomes associated with substance co-use.

The past 10–15 years show a change in the landscape of substance use behavior in young adults, with risky alcohol use stabilizing; binge and heavy drinking and cigarette smoking declining; and non-cigarette tobacco use, marijuana use, and poly-substance all increasing. For example, comparisons across annual reports of the National Survey of Drug Use and Health from 2008 to the most recent report (2016), show decreases in young adult binge drinking (41% in 2008–38.4% in 2016), heavy drinking (14.5% in 2008–10.1% in 2016), Patterns of use by tobacco product type, age group, and co-use with other substances have also shown notable changes.^{3,9,13} Past month cigarette smoking has decreased significantly among young adults,¹³ from 35.7% in 2008–23.5% in 2016^{1,14,15}; while e-cigarette, hookah, and cigar product use (8.8% of young adults report past-month cigar use) have become more popular, as has dual and poly-tobacco use.^{2,3,16,17} Marijuana and tobacco co-use is reported by approximately 14% of young adults; marijuana smoking in a cigar (ie, blunt use), is increasingly prevalent among US young adult marijuana users, increasing from 57% in 2005–60.4% in 2012.^{9,18}

Studies suggest that alcohol, marijuana, and tobacco use cluster together in different ways. For example, results from a national sample of young adults showed that current alcohol use was most strongly correlated with past 30-day hookah use and least strongly correlated with past 30-day cigarette use. Conversely, current marijuana use was most strongly correlated with past 30-day use of LCCs and least strongly correlated with past 30-day use of hookah.⁵ The association of e-cigarette use with alcohol and marijuana also appears to be much weaker than the association of e-cigarettes with other tobacco products.¹⁹ Further, in a national sample of young adults, the co-use of e-cigarettes with alcohol and marijuana was found to be less common than the co-use of other tobacco products with alcohol and marijuana.⁶ Data from the National Survey of Drug Use and Health (2003–2012) shows that current cigarette use is more common among older adult marijuana users compared to young

adult marijuana users¹⁸; while cigar/blunt smoking and poly-tobacco use are more common among young adult marijuana users.^{10,18} Latent class analyses with young adults also reveal differences across and within types of alcohol, marijuana, and tobacco users. One recent study found that young adult poly-tobacco users were more likely to be recent marijuana users and binge drinkers compared to non-poly-tobacco users; young adults who used smokeless tobacco (snuff/snus) were the least likely to report past 30-day marijuana use.²⁰ Another latent class analysis of young adults showed that hookah users were heterogeneous with respect to tobacco product use, with one group using predominantly tobacco products, but not other drugs, and another group engaging in poly-substance use behavior and having elevated risk for illicit drug use.²¹

Dual and poly-substance use of alcohol, marijuana, and tobacco products are particularly prevalent in populations with mental health and substance use problems,^{22,23} with onset of these problems typically occurs during young adulthood.²⁴ Prior research on associations between mental illness and substance use behavior indicate multiple different pathways to comorbidity. Some theories suggest the co-occurrence of mental illness with substance use behavior arise from underlying biological, environmental, or psychosocial vulnerabilities to engage in health-risk behaviors.²⁵ Some studies show that mental health issues make individuals vulnerable to experimentation with substances,^{26,27} while others suggest that alcohol, marijuana, and tobacco use, alone or together, increase risk for onset of, or worsening in mental health problems.^{3,9,28,29} Few research studies have revealed specific sub-patterns of substance use and co-use that may be more or less prevalent among those with mental illness than without. Such information would be useful in determining for whom public health messages about the risks associated with substance use should be directed. This is urgently needed, particularly given the rapid increase in emerging tobacco product use among young adults in recent years.

While data on tobacco product and substance use have been published from the Population Assessment of Tobacco and Health (PATH) Study,^{4,30–33} there has been no detailed examination of the patterns and combinations of these products beyond correlational analyses. To fill this gap, this paper used contemporary US population-based data to examine two aims. Aim 1 sought to characterize, at the population-level, the most common patterns/combinations of alcohol, marijuana, tobacco product use, and co-use across the range of tobacco products (cigarettes, e-cigarettes, cigars/little cigars, hookah), among young adults 18–24 and adults 25 years of age and older. Aim 2 examined substance use and mental health problems as correlates of these patterns of use. With this aim we sought to determine whether there exist different profiles or “typologies” of substance use by those with and without problem behaviors. Rather than providing overall prevalence estimates or bivariate associations between alcohol, tobacco, and marijuana to identify patterns of risk, as has been done in other studies,^{4,31} findings from this paper will inform the field by revealing the most popular combinations of substance use and co-use that differ by young adults and older adults. This information can be used to improve regulatory efforts and prevention campaigns that seek to reduce the public health burden of the most common and deleterious patterns of substance use. Examining differences between younger and older adults can help further refine prevention/intervention targets, such that these programs are maximized to appeal to different age groups. If multiple use patterns are highly prevalent, messaging

campaigns should target multiple health-risk behaviors, rather than focus on a single behavior.

METHODS

Respondents

Data are from the adult Wave 1 survey of the PATH Study (2013–2014), a nationally representative cohort study of 45,971 adults and youth in the United States, ages 12 years and older. This analysis draws from 32,320 adults (18 years old). Recruitment involved address-based, area-probability sampling, using an in-person household screener to select participants. The weighting procedures adjusted for oversampling of young adults (ages 18–24), adult tobacco users, and African–American and nonresponse to yield representative estimates of the non-institutionalized, civilian US population in 2013–2014. Further details regarding the PATH Study design and methods are available elsewhere.³⁴ This study used de-identified data available from the restricted use files hosted by the National Addiction & HIV Data Archive Program (NAHDAP) (<http://goo.gl/sABEjv>) and was determined exempt by Chesapeake IRB (Pro00015910).

Measures

Demographics—Sociodemographic variables included gender, race (White and non-White), ethnicity (Hispanic and Non-Hispanic), education (completed at least some college [yes/no]), and income (\$24,999 or below, \$25,000–\$49,999, \$50,000–\$99,000, \$100,000 or above). Due to small sample sizes, education and race were collapsed into dichotomous groups.

Tobacco Use—Current use of cigarettes, e-cigarettes, traditional cigars, cigarillos, filtered cigars, hookah, pipe, smokeless tobacco, snus, and dissolvable tobacco was defined in two ways: (1) currently smoking/using “some days” or “every day” (or “weekly” or “monthly” for hookah) or (2) use in the past 30 days. Those using hookah “weekly” or “monthly” were categorized as current users. Traditional cigars, cigarillos, and filtered cigars were combined into one “any cigar” group. Pipe tobacco, smokeless tobacco, snus, and dissolvable tobacco were combined into an “other tobacco” group due to low prevalence. Past 30-day blunt use was not queried in the survey. To maintain consistency in how we operationalized co-use in the current paper (use of any two products in the past 30-days), we did not include past year blunt use in our analyses.

Substance Use Behavior—Dichotomized measures of past 30-day use (yes/no) of alcohol, marijuana, and other drug use (cocaine/crack, stimulants, painkillers/sedatives/tranquilizers, or “any other drug, like heroin, inhalants, solvents, or hallucinogens”) were used in analyses. Participants responded to the item stem “how long has it been since you last used...” with response options for alcohol, marijuana, and illicit drug use: “Within the past 30 days,” “More than 30 days ago but within the past year,” or “More than a year ago.” Respondents who selected “within the past 30-days” were categorized as past 30-day users of that substance.

Mental Health and Substance Problems—Items from the Global Appraisal of Individual Needs–Short Screener (GAIN-SS)^{4,31} captured internalizing disorders (eg, “When was the last time that you had significant problems with ... Feeling trapped, lonely, sad, blue, depressed, or hopeless about the future?” [4 items]), externalizing disorders (eg, “When was the last time that you did the following things two or more times ... Lied or conned to get things you wanted or to avoid having to do something?” [5 items]), and substance use problems (eg, When was the last time you ... used substances at least weekly, spent a lot of time obtaining substances, reduced involvement in activities due to the use of substances, had problems with withdrawal [7 items]).³⁵ For each item, participants indicated when they most recently experienced the problem: “Never,” “1+ years ago,” “2 to 12 months ago,” and “Past month.” The GAIN scale uses the following severity threshold cut-points, assessing symptoms in the past year: 0–1 symptoms (low), 2–3 symptoms (moderate), and 4/4+ (high, depending on the scale). Aligning with previous studies using the GAIN-SS, including those recently published from PATH data, individuals were defined as having mental health problems if they reported four symptoms in the past year on the internalizing or >4 symptoms on externalizing scale. Individuals were defined as having substance use problems if they reported >4 symptoms in the past year on the substance use scale.
4,31,32,35,36

Analytic Plan

Weighted prevalence estimates examined overall sample characteristics. Next, population-level prevalence of all patterns of alcohol, marijuana, and tobacco product use and co-use were estimated separately for young adults (ages 18–24) and older adults (age 25+) with a user-generated program developed in R that has been used in previously published work.⁶ This program listed every pattern of current use (yes/no) across all substances of interest (alcohol, marijuana, cigarettes, e-cigarettes, any cigar, hookah, and other tobacco). Pearson’s chi-square tests were used to estimate significant differences in pattern prevalence between young adults and adults 25+ with significance at $p < .05$.

Pattern indicator variables were saved in Stata and used as outcomes in multivariable logistic regression models that examined substance use and mental health problems as correlates of each of the top five patterns of use and co-use, controlling for demographics. Models were stratified by age group. For ease of interpretation, we focused our analyses on only the five most common patterns across each age group. Models used “alcohol-only use” as the reference group because it is the most popular substance among young adults^{5,6}. We had considered “no use” of any product as the reference group, however previous research, including published work from PATH, has demonstrated differences between substance users and non-users on demographic and mental health factors.^{4,37,38} Analyses were conducted using SVY procedures in Stata/MP version 14.1 to account for weighting to represent the US population.

RESULTS

Sample Characteristics: Overall and by Age Group

Table 1 shows sample characteristics overall and by age groups. In the overall sample, 50.7% reported past 30-day alcohol use, 7.1% reported past 30-day marijuana use, and 5.6% reported past 30-day other drug use. Cigarettes were the most common tobacco product currently used by the full sample (22.8%), followed by hookah (11.4%), cigar products (7.3%), e-cigarettes (6.9%), and then other tobacco products (4.4%). Among the full sample, 15.9% reported past-year mental health problems and 3.5% reported past-year substance use problems.

Among young adults, 51.2% reported past 30-day alcohol use, 17.5% reported past 30-day marijuana use, and 4.5% reported past 30-day other drug use. Cigarettes were the most common tobacco product currently used by young adults (29.1%), followed by hookah (21%), cigars (16.2%), e-cigarette (13.1%), and other tobacco products (7.4%). In the past year, 29.9% of young adults reported mental health problems and 7% reported substance use problems.

Among older adults (aged 25+), 50.6% reported past 30-day alcohol use, 5.5% reported past 30-day marijuana use, and 5.8% reported past 30-day other drug use. Cigarettes were also the most common tobacco product currently used in this age group (21.8%), followed by hookah (6.2%), cigars and e-cigarettes (both 6.0%), and other tobacco use (4.0%). In the past year, 13.8% of adults reported mental health problems and 3.0% reported substance use problems.

Population Prevalence of Patterns of Alcohol, Marijuana, and Tobacco Product Use and Co-Use by Age Group

Table 2 shows the population prevalence of the 10 most common patterns of alcohol, marijuana, and tobacco product use and co-use by age group. Across both age groups, dual use and poly-substance use were more common than single substance use. The prevalence estimates of most of the top 10 patterns differed by age group, except for alcohol/cigarettes/e-cigarette co-use ($p = .76$). No use of anything (33.5% in young adults and 36.3% in adults) and alcohol-only use (20.7% in young adults and 32.2% in adults) were the two most common patterns in both age groups. Alcohol emerged in six out of the 10 most common patterns across both age groups. Cigarette-only use was the fourth most common pattern among young adults (3.5%) and third most common pattern among older adults (5.5%). Within the top 10 patterns, e-cigarette use occurred in only one pattern for young adults and two patterns for adults 25+ years old. Further, across both age groups, e-cigarette use was represented in less common patterns (Pattern 8 for young adults; Patterns 5 and 6 for older adults) and was always currently used with cigarettes.

Several of the top 10 patterns were unique to young adults and did not emerge in the top 10 patterns for older adults, such as: alcohol/hookah co-use (Pattern 6; 1.9%), alcohol/cigarettes/marijuana/cigar co-use (Pattern 9, 1.2%) and alcohol/cigarettes/cigar co-use (Pattern 10; 1.2%). In contrast, several patterns were unique to older adults and did not emerge in the top 10 patterns for young adults, such as: cigarettes/e-cigarette co-use (Pattern

6; 1.2%), alcohol/cigar co-use (Pattern 7; 1.1%), and alcohol/other tobacco co-use (Pattern 9; 1.0%). Finally, compared to older adults, young adults reported using substances in a wider variety of ways, with 26.8% engaging in “other” substance use patterns (beyond the top 10), while only 12.6% of older adults reported “other” substance use patterns.

Multivariable Adjusted Regression Models

Results of adjusted logistic regression models of the associations of mental health and substance use problems with the top five patterns of use and co-use, compared to alcohol-only use are shown in Table 3 (young adults) and Table 4 (adults 25 years+).

Young Adults

In multivariable models, mental health problems were associated with higher odds of engaging in alcohol/marijuana co-use (AOR=1.57; CI: 1.13, 2.20), alcohol/hookah co-use (AOR: 1.48, CI: 1.03, 2.13), and alcohol/cigarettes/marijuana co-use (AOR=1.72, CI: 1.19, 2.48), compared to alcohol-only use. Mental health problems were most strongly correlated with the pattern of alcohol/cigarettes/marijuana co-use. Mental health problems were not associated with the patterns of cigarettes-only use (AOR=.85, CI: .61, 1.20) or alcohol/cigarettes co-use (AOR=1.15; CI: .87, 1.54), compared to alcohol-only use.

Substance use problems were associated with higher odds of engaging in all patterns of use (relative to alcohol-only use), except for cigarette-only use (AOR=.54; CI: .19, 1.52).

Substance use problems were most strongly correlated with alcohol/cigarettes/marijuana co-use (AOR=6.19; CI: 3.61, 20.63).

Older Adults

In multivariable models, mental health problems were associated with higher odds of engaging in all patterns of use and co-use compared to alcohol-only use, except for alcohol/cigar co-use (AOR=1.20; CI: .83, 1.74).

Substance use problems were associated with lower odds of engaging in cigarettes-only use compared to alcohol-only use (AOR=.62; CI: .39, .99) and associated with higher odds of engaging in three patterns that included both cigarettes and alcohol use: alcohol/cigarettes co-use (AOR=2.17; CI: 1.47, 3.21), alcohol/cigarettes/e-cigarette co-use (AOR 2.22; CI: 1.43, 3.44), and alcohol/cigarettes/marijuana co-use (AOR =4.64, CI: 3.10, 6.94). Substance use problems were not correlated with cigarette/e-cigarette co-use (AOR=.88; CI: .47, 1.62), or with alcohol/other tobacco co-use (AOR=1.39; CI: .80, 2.42).

DISCUSSION

Across both age groups, no current use of any product and past 30-day alcohol-only use were the two most common patterns, and alcohol was predominant in nearly all the ten most common patterns. Dual and poly-substance use were also common patterns, and most co-use profiles included cigarettes and alcohol. In fact, dual and poly-use patterns emerged more often than single use patterns, regardless of age group. Across both age groups, none of the non-cigarette tobacco products were currently used alone, they were also used with alcohol,

marijuana, or another tobacco product. Overall, e-cigarettes were less popular than other tobacco products in young adult and older adult age groups, as use of e-cigarettes occurred in less common patterns. Unique to young adults were two patterns with current hookah use, in line with national studies showing increasing prevalence of hookah use in this age group.³⁹ Alcohol/cigars co-use, cigarettes/e-cigarette co-use, and alcohol/other tobacco co-use were unique patterns that emerged in the top 10 for older adults. Marijuana-only use, marijuana/cigar co-use, and current hookah/cigarettes co-use did not emerge in the top 10 patterns among young adults, despite national studies showing popularity of marijuana smoking in a cigar (ie, blunt smoking), and high rates of dual use of cigarettes and hookah in this age group.^{9,10,18,40} These forms of substance co-use, while prevalent, may not be as common in this age group as the use of alcohol or cigarettes alone or in combination with marijuana. However, blunt use was omitted from analyses because it was only asked of past-year but not past 30-day users.

Substance use problems were most strongly correlated with the pattern of alcohol/cigarettes/marijuana co-use in both age groups. It is important to note that, when used alone, alcohol or cigarettes were associated with significantly lower mental health and substance use risk than when they were used together, across both age groups. According to Vanyukov's theory of liability to substance use disorders,²⁵ poly-substance users, versus single or dual users, may have a higher degree of underlying vulnerabilities. This should be explored in future studies. Interestingly, mental health and substance use problems showed the same degree of association with cigarette- and alcohol-only use in young adults, but showed divergent associations to these patterns among older adults. Specifically, older adults with mental health problems were significantly more likely to engage in cigarette-only use (vs. alcohol-only use) while those with substance use problems were significantly less likely to engage in cigarette-only use (vs. alcohol-only use). This may be because older adults with substance use problems are using a broader range of tobacco products, beyond just cigarettes. Other patterns that were weakly or not significantly correlated with either mental health or substance use problems, like alcohol/hookah co-use among young adults, and cigarettes/e-cigarette co-use among older adults may include experimental or occasional users who use substances not because of an underlying psychological vulnerability, but because of peer or social pressures, social setting, availability, or general curiosity.²⁵

This study had several limitations. First, analyses were limited to the measures and questions available in the current survey. Opioid use, and as well as biological or genetic factors associated with heightened proclivity toward substance use were not available in the PATH survey. Further, items querying about simultaneous (ie, in the same session) or concurrently (ie, during the same month) use were not asked in the PATH survey. How co-use is defined (concurrent vs. simultaneous) is an important distinction that could correlate with problems experienced. Second, we captured patterns of behavior at one point in time. Individuals, especially young adults, may move in and out of patterns of substance use over time and pattern popularity may have changed. For example, the analyses draw on data from 2013 to 2014 and e-cigarette use may have increased. Given the changing landscape of e-cigarettes and other tobacco products, caution must be taken in making any claims about these findings, especially for young people. Third, alcohol and marijuana use are ascertained in the preceding 30 days, without measuring frequency of use in that period. This approach was

dictated by the analyses we chose, in which any product use, rather than intensity of use, was the primary factor on which products could be clustered together. Fourth, the findings include unadjusted frequencies of different substance use patterns, some of them including small prevalence estimates (1–3%), similar to Kasza et al.³⁰ who also reported unadjusted frequencies of common combinations of tobacco products.

This study adds to the literature in several ways. First, this study provided new information on the most common combinations of alcohol, marijuana, and tobacco product use, beyond simple prevalence estimates and correlations.^{4,30,31} Second, unlike other national datasets of substance use behavior (eg, NESARC or NSDUH), PATH includes questions about hookah and e-cigarette use, two very popular tobacco products among young adult users. When alcohol and marijuana use are included into the pattern profiles of tobacco product use, our findings showed that e-cigarette use appears to be less popular than use of these other substances, an important result for stakeholders who are concerned about the impact of e-cigarette use on public health. Third, rather than describing overall prevalence of and associations between alcohol, marijuana, and tobacco product use, as in prior work,³⁰ or cluster respondents based on their use patterns (person-centered approach like Latent Class Analysis), we took a product-centered approach to reveal the most popular combinations of products use and co-use, an approach similar to our previous work.⁶ With clustering techniques, we would not be able to discern the frequency with which products are used together, or whether one cluster or pattern is more, or less common than another. Instead, our approach allowed for product-specific patterns based on frequency or popularity of pattern occurrences. Furthermore, our user-generated R program identified all possible patterns within the data, rather than distill patterns into smaller sub-groups based on an a priori grouping, such as with latent class analysis. Fourth, we demonstrated that patterns and correlates of use differed by age group. This information can be used to refine prevention strategies to deter uptake in new or never users and improve strategies targeting supply, price, and availability of products to older users.

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Sample characteristics of young adults (ages 18–24) and older adults (ages 25 years and older) from wave 1 of the population assessment of tobacco and health adult wave 1 survey, 2013–2014 ($n=32,320$)

TABLE 1.

	Unweighted n	Young adults (18–24 years old) (%)	Older adults (25+ years old) (%)	Overall (%)
Age				
18–24	9,110	100.0	–	13.0
25–34	–	–	20.4	17.7
35–44	–	–	19.0	16.5
45–54	–	–	20.6	17.9
55–64	–	–	19.1	16.6
65–74	–	–	12.8	11.1
75+	–	–	8.2	7.1
Sex				
Male	50.3	50.3	47.8	48.1
Female	49.7	49.7	52.3	51.9
Race				
Non-white	30.2	30.2	21.0	22.2
White	69.9	69.9	79.0	77.9
Ethnicity				
Non-Hispanic	79.3	79.3	85.9	85.0
Hispanic	20.7	20.7	14.1	15.0
Some college education				
No	43.3	43.3	40.4	40.8
Yes	56.7	56.7	59.6	59.2
Income				
\$24,999 or below	53.5	53.5	31.2	34.1
\$25,000–\$49,999	19.4	19.4	23.6	23.1
\$50,000–\$99,999	15.8	15.8	26.2	24.9
\$100,000 or above	11.2	11.2	19.0	18.0
Mental health problems^a				

	Young adults (18–24 years old) (%)	Older adults (25+ years old) (%)	Overall (%)
Unweighted <i>n</i>	9,110	23,210	32,320
No	70.1	86.2	84.1
Yes	29.9	13.8	15.9
Substance use problems ^a			
No	93.0	97.1	96.5
Yes	7.0	3.0	3.5
Current tobacco use ^b			
Cigarettes	29.1	21.8	22.8
E-cigarettes	13.1	6.0	6.9
Any cigar product ^c	16.2	6.0	7.3
Other tobacco products ^d	7.4	4.0	4.4
Hookah	21.0	6.2	11.4
Past 30-day substance use			
Alcohol	51.2	50.6	50.7
Marijuana	17.5	5.5	7.1
Other drugs	4.5	5.8	5.6

^a Individuals were defined as having mental health problems if they reported four or more symptoms in the past year on either the internalizing (4 items) or externalizing (5 items) severity sub-scale of the GAIN-Short Screener. Individuals were defined as having substance use problems if they reported four or more symptoms (7 items) in the past year on the substance use severity sub-scale.

^b Current use was defined in two ways: (1) currently smoking/using “some days” or “every day,” (or “weekly” or “monthly” for hookah) or (2) use in the past 30 days. For hookah users, those who responded “not at all” but who reported using “weekly” or “monthly” were categorized as current hookah users.

^c Traditional cigars, cigarillos, and filtered cigars were combined into one “any cigar” group.

^d Due to low prevalence, pipe tobacco, smokeless tobacco, snus, and dissolvable tobacco were combined into an “other tobacco” group.

Weighted population-level prevalence of alcohol, marijuana, and tobacco product use and co-use patterns by age group from the population assessment for tobacco and health wave 1 (2013–2014)

TABLE 2.

Pattern	Pattern popularity by age group		18-24 year olds (unweighted $n = 9,110$)		25+ year olds (unweighted $n = 23,210$)			
	Pattern popularity age 18-24	Pattern popularity age 25+	n 's (unweighted)	Prevalence (weighted) (%)	95%CI	n 's (unweighted)	Prevalence (weighted) (%)	95%CI
No current use*	1	1	2,197	33.5	(31.1, 36.0)	4,583	36.3	(34.9, 37.7)
Alcohol-only use*	2	2	1,477	20.7	(19.5, 22.0)	4,801	32.2	(30.9, 33.5)
Alcohol/cigarettes co-use*	3	4	444	3.7	(3.3, 4.2)	2,559	5.4	(5.1, 5.7)
Cigarettes-only use*	4	3	459	3.5	(3.2, 3.9)	2,691	5.5	(5.2, 5.8)
Alcohol/marijuana co-use*	5	8	233	2.6	(2.2, 3.1)	258	1.1	(.9, 1.3)
Alcohol/hoopah co-use*	6	-	210	1.9	(1.6, 2.2)	92	.2	(.2, .3)
Alcohol/cigarettes marijuana co-use*	7	10	171	1.5	(1.3, 1.7)	462	.9	(.8, 1.0)
Alcohol/cigarettes/e-cigarette co-use	8	5	156	1.3	(1.1, 1.5)	674	1.4	(1.3, 1.5)
Alcohol/cigarettes/marijuana/ cigar co-use*	9	-	155	1.2	(1.0, 1.4)	191	.4	(.3, .4)
Alcohol/cigarettes/cigar co-use*	10	-	140	1.2	(1.0, 1.4)	369	.8	(.7, .9)
Cigarettes/e-cigarette co-use*	-	6	95	.7	(.5, .9)	645	1.2	(1.1, 1.4)
Alcohol/cigar co-use	-	7	94	.9	(.7, 1.1)	435	1.1	(1.0, 1.2)
Alcohol/other tobacco co-use	-	9	75	.7	(.5, .8)	456	1.0	(.9, 1.2)
All other patterns*	-	-	3,204	26.8	(25.4, 28.2)	4,995	12.6	(12.1, 13.1)

* "-" indicates pattern popularity below top 10 rank within age group. Pattern ranking based on weighted prevalence not on unweighted count.

* Significant difference by age group at $p < 0.05$.

TABLE 3.

Adjusted multinomial logistic regression models assessing mental health and substance use problems as correlates of the top 5 most common patterns of alcohol, marijuana, and tobacco product use and co-use among US young adults aged 18–24 (unweighted $n = 9,110$)

	Pattern 3 cigarettes-only use (vs. alcohol-only use)		Pattern 4 alcohol/cigarettes co-use (vs. alcohol-only use)		Pattern 5 alcohol/marijuana co-use (vs. alcohol-only use)		Pattern 6 alcohol/hookah co-use (vs. alcohol-only use)		Pattern 7	
	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
Mental health problems (vs. no)	0.85	(.61, 1.20)	1.15	(.87, 1.54)	1.57	(1.13,2.20)	1.48	(1.03,2.13)	1.72	(1.19, 2.48)
Substance use problems (vs. no)	0.54	(.19, 1.52)	2.41	(1.40, 4.16)	2.50	(1.23,5.06)	1.97	(1.04,3.74)	6.19	(3.61, 10.63)

Models adjusted for gender, race (White vs. non-White), Hispanic ethnicity, education (at least some college—yes/no), and income.

Bold text indicates $p < .05$.

TABLE 4.

Adjusted multinomial logistic regression models assessing mental health and substance use problems as correlates of the top five most common patterns of alcohol, marijuana, and tobacco product use and co-use among US adults 25+ years old (unweighted $n = 23,210$)

	Pattern 3 cigarettes-only use (vs. alcohol-only use)		Pattern 4 alcohol/cigarettes co-use (vs. alcohol-only use)		Pattern 5		Pattern 6 cigarettes/e-cigarette co-use (vs. alcohol-only use)		Pattern 7	
	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
Mental health problems (vs. no)	1.19	(1.03, 1.38)	1.50	(1.28, 1.75)	1.55	(1.24, 1.93)	1.69	(1.30, 2.20)	1.60	(1.20, 2.14)
Substance use problems (vs. no)	.62	(.39, .99)	2.17	(1.47, 3.21)	2.22	(1.43, 3.44)	.88	(0.47, 1.62)	4.64	(3.10, 6.94)

Models adjusted for gender, race (White vs. non-White), Hispanic ethnicity, education (at least some college - yes/no), and income.

Bold text indicates $p < .05$.